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SPECIAL PUBLICATION ARCCB-SP-01009

INDEX TO BENET LABORATORIES TECHNICAL REPORTS - 2000

R. D. NEIFELD

MAY 2001



US ARMY ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

CLOSE COMBAT ARMAMENTS CENTER BENÉT LABORATORIES WATERVLIET, N.Y. 12189-4050



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1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE ANI	D DATES COVERED
	May 2001	Final	
4. TITLE AND SUBTITLE			5. FUNDING NUMBERS
INDEX TO BENET LABORATORIES TECHNICAL REPORTS - 2000			N/A
6. AUTHOR(S) R.D. Neifeld			
7. PERFORMING ORGANIZATION NAM	E(S) AND ADDRESS(ES)		8. PERFORMING ORGANIZATION REPORT NUMBER
U.S. Army ARDEC Benet Laboratories, AMSTA-AR-CCB-0 Watervliet, NY 12189-4050	0		ARCCB-SP-01009
9. SPONSORING/MONITORING AGENC	Y NAME(S) AND ADDRESS(ES)		10. SPONSORING / MONITORING AGENCY REPORT NUMBER
U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION / AVAILABILITY STA	TEMENT		12b. DISTRIBUTION CODE
Approved for public release; distribution	unlimited.		
13. ABSTRACT (Maximum 200 words)			
This is a compilation of technical reports	s published by Benet Laboratorie	s during 2000.	
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(6			
14. SUBJECT TERMS			15. NUMBER OF PAGES
Benet Laboratories, Technical Publication	ons, Bibliographies, Abstracts, D	ocument Control Data	26 16. PRICE CODE
17. SECURITY CLASSIFICATION 18.	SECURITY CLASSIFICATION	19. SECURITY CLASSIFI	CATION 20. LIMITATION OF ABSTRACT

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ARCCB-TR-00015	A383 883
ARCCB-TR-00016	A387 401

Form Approved OMB No. 0704-0188

Public reparting burden for this collection of in gathering and maintaining the data needed, an collection of information, including suggestions Davis Highway, Suite 1204, Arlington, VA. 2220.						
1. AGENCY USE ONLY (Leave blas			3. REPORT TYPE AND DATES			
		January 2000	Final			
4. TITLE AND SUBTITLE				5. FUND	ING NUMBERS	
EROSION EFC FACTORS FOR KI ROUNDS USED IN THE 120-MM				PR	ON No. J5850E52M21A	
6. AUTHOR(5)						
Samuel Sopok and Roger Billington Picatinny Arsenal, NJ 07806)	(PM-TM	IAS,				
7. PERFORMING ORGANIZATION N	AME(S)	AND ADDRESS(ES)			DRMING ORGANIZATION RT NUMBER	
U.S. Army ARDEC Benct Laboratories, AMSTA-AR-CO Watervliet, NY 12189-4050	СВ-О			AI	RCCB-TR-00001	
9. SPONSORING/MONITORING AG	ENCY NA	ME(S) AND ADDRESS(ES)		ISORING/MONITORING NCY REPORT NUMBER	
U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000						
11. SUPPLEMENTARY NOTES Presented at the 35 th AIAA Joint Pro Published in proceedings of the conf		Conference, Los Angeles, (CA, 20-24 June 1999.			
12a. DISTRIBUTION / AVAILABILITY	STATEM	ENT		12b. DIS	TRIBUTION CODE	
Approved for public release; distribu	ition unli	mited.				
13. ABSTRACT (Maximum 200 word	ds)			<u> </u>		
The U.S. Army and Air Force's standard also designates erosion condemnation or charge/projectile combination. These or factor for each charge/projectile combination cours much quicker than fatigue condexperimental method using the Unified M829A2 kinetic energy round types use obvious extension of this method to any factors are based on an erosion EFC fact crosion factors correspond to a peak erosion und types at a 49°C round-conditioning erosion EFC factors are approximately approximately 0.7, 1.9, 2.2, and 2.8 at a for an equal distribution of these three mabove technical manual and help the Arrosion life and erosion EFC factors are type and conditioning temperature-depen of magnitude more limiting than its associations.	manual for iteria for e tieria help ation. This manion v Cannon E du in the 11 / group of tor of 1.0 ion locatic g temperal 1.0, 2.8, -32°C roun ound-cond my managanofficially dent. M2	ach cannon tube type, and de in cannon inventory managers is represents a notable technically designed by the latest charge/particle to the latest charge/particle combination of the M865 round type at a mapproximately 2.2 meters find the latest charge projectile combination for the M865 round type at a mapproximately 2.2 meters find the latest charge provided conditioning temperature. M256 and d-conditioning temperatures. M256 inventory. They by specified in this work, and w 56 cannon erosion-related inventor properties of the latest charge provided in the latest charge	signates a cartridge/zone fatigment. However, the manual I gogy gap for tank and artillery projectile combinations. Our artridge or round erosion ER multiple round-conditioning as used in a specific tank or . 21°C round-conditioning tem our the rear face of the tube. C factors are approximately I ad-conditioning temperature, The respective erosion ERC for cannon fatigue life and fatiguare not round type or conditionill further help the Army man	que effective acks a designon cannon sys report outile factor for temperature artillery car uperature as For the M86 5, 4.2, 5.0, and the re actors are ague EFC factor oning temperature are its M25 are its M25 account properties actor are ague EFC factor oning temperature are its M25 are its M25 account are actor are ague are ague ag ag ag ag ague ag ag ag ag ag ag ag ag ag ag	e full charge (EFC) factor for each matted cartridge/zone crosion EFC terms, since crosion condemnation incs a detailed computational and the M865, M829, M829A1, and is. Our report further outlines the mon. The following crosion EFC requested by PM-TMAS. These 55, M829, M829A1, and M829A2 and 6.3. Similarly, the respective spective crosion EFC factors are approximately 1.1, 3.0, 3.5, and 4.4 stors are officially specified in the crature-dependent. M256 cannon in inventory. They are both round a crosion life can be up to an order	
14. SUBJECT TERMS					15. NUMBER OF PAGES 18	
Gun Barrel Erosion, Kinetic Energy Kinetic Energy Round Erosion, 120-					16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT		URITY CLASSIFICATION THIS PAGE	19. SECURITY CLASSIFI OF ABSTRACT	CATION	20. LIMITATION OF ABSTRACT	
UNCLASSIFIED	UNCLA	SSIFIED	UNCLASSIFIED		UL .	

NSN 7540-01-280-5500

Standard Form 298 (Rev 3-89)

Form Approved REPORT DOCUMENTATION PAGE OMB No 0704-0188 Public reporting burden for the vallection of information is estimated to average to our per reporter, including the time for reviewing instructions, searning easing data sources, gathering and maintaining the data needed, and combining and reviewing the objection of information. Send comments regarding this burdent estimate or any stress assent of this following of information, including suggestions for reducing this outlent to Washington Heaviern Services, Directories for information Depressions for reducing this outlent to Washington Heaviern Services, Directories for information Depressions for reducing this outlent to Washington Heaviern Services, Directories for information Depressions and Reports, 215 refferon Davis Highway, State 1204, Artington, VA 22202-4302, and its the Office of Monagement and Sudget, Processor's Reduction Project (0704-0188), Washington, Dr. 2050.3. 3. REPORT TYPE AND DATES COVERED 2. REPORT DATE 1. AGENCY USE ONLY (Leave blank) January 2000 4. TITLE AND SUBTITLE 5. FUNDING NUMBERS LEAD-TIN SOLDER CHARACTERIZATION BY PRON No. 4EE2B069EH1A DIFFERENTIAL SCANNING CALORIMETRY 6. AUTHOR(S) Mark F. Fleszar PERFORMING ORGANIZATION REPORT NUMBER 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army ARDEC Benet Laboratories, AMSTA-AR-CCB-O ARCCB-TR-00002 Watervliet, NY 12189-4050 10. SPONSORING / MONITORING 9, SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) AGENCY REPORT NUMBER U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000 11. SUPPLEMENTARY NOTES Presented at the 27th North American Thermal Analysis Society Conference, Savannah, GA, 20-23 September 1999. Published in proceedings of the conference. 12b. DISTRIBUTION CODE 12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited. 13. ABSTRACT (Maximum 200 words) The electrolytic deposition of chromium on the bore of thick-walled, high-pressure cylinders uses a lead-tin alloy as the anode for the plating process. The anode is prepared by melting a lead-tin solder over a cylindrical copper core, which is then machined to the proper diameter. Using differential scanning calorimetry, the melting temperature of various ratios of lead-tin can be measured and a portion of the phase diagram can be established between the solid and liquid states. The melting temperature of a solder can then be measured and the composition can be obtained from the phase diagram. 15. NUMBER OF PAGES 14. SUBJECT TERMS Thermal Analysis, Lead-Tin Alloy, Differential Scanning Calorimetry, Inductively Coupled Plasma Emission Spectroscopy 16. PRICE CODE SECURITY CLASSIFICATION OF THIS PAGE SECURITY CLASSIFICATION OF ABSTRACT 20. LIMITATION OF ABSTRACT 17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED UNCLASSIFIED UNCLASSIFIED

Standard Form 298 (Rev. 2-89) Preumbed by ANSI Std. 239-18 298-102

NSN -7540-01-280-5500

Form Approved OMB No. 0704-0188

Public reporting burden for this collection of in gathering and maintaining the data needed, an collection of information, including suggestion Davis Highway, Suite 1204, Arimgton, VX 2220.	in masson is essentified to average — nour of d completing and reviewing the callection for reducing this burden, to Washington H 14302, and to the Office of Management in	or information. Imma committee engalassis illustrational formation of the formation of the state of the formation of the state of the s	tion Operations and Reports, 1235 Jefferson 6188), Washington, OC 20923.
1. AGENCY USE ONLY (Leave blan	k) 2. REPORT DATE February 2000	3. REPORT TYPE AND DATE	ES COVERED
4. TITLE AND SUBTITLE PRELIMINARY EROSION ANAL EXPERIMENTAL M829E3 KINET	FUNDING NUMBERS PRON No. J5850E52M21A		
6. AUTHOR(S) S. Sopok, R. Loomis (Picatinny Arso G. Pflegl, and C. Rickard	enal, Dover, NJ),		
7. PERFORMING ORGANIZATION N	AME(S) AND ADDRESS(ES)		RFORMING ORGANIZATION PORT NUMBER
U.S. Army ARDEC Benet Laboratories, AMSTA-AR-Co Watervliet, NY 12189-4050	CB-O		ARCCB-TR-00003
9. SPONSORING / MONITORING AG	ENCY NAME(S) AND ADDRESS(I	ES) 10. SF A(ONSORING/MONITORING SENCY REPORT NUMBER
U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			
11. SUPPLEMENTARY NOTES Presented at the 36th JANNAF Comb Published in proceedings of the mee		Space Center, FL, 17-22 October 1	999.
12a. DISTRIBUTION/AVAILABILITY	STATEMENT	12b. I	DISTRIBUTION CODE
Approved for public release; distribu	tion unlimited.		
cycle that occurred about a half yea and laboratory data, including data fi information is intended to provide M829E3 kinetic energy round. Dur round minimum program target, so optimizations will likely include cha of this erosion analysis, erosion effe are provided for the preliminary econditioning temperatures. The conthe preliminary experimental M829 weight, increased projectile weight, energy round erosion analysis achiev more than a half meter up-bore comp	ntal 120-mm M829E3 kinetic entry to a year ago. The computation or firing tests, laboratory tests, a "snapshot" of development for ing that period, these modeling programmer for further round optimization will nges in the weight and configuration of the weight and configuration of the weight and configuration of the weight and consisted of the weight and weight	and nondestructive/destructive cannot that period, and is not directly repredictions put the program about 4 likely contribute to the achievement on of the propellant, projectile, call and comparisons to the round's advergy round used in the 120-mm hasing our Unified Cannon Erosion advanced type-classified counterpate of JA2 propellant. The prelimina ser number of rounds, and the worst	and supported by substantial field on erosion characterizations. This lated to the future type-classified 0 rounds shy of its required 180-tent of this goal. Further round se, and possible ablative. Results vanced type-classified counterpart M256 cannon at multiple round-Code. Differences exist between art including increased propellant try experimental M829E3 kinetic
14. SUBJECT TERMS Cannon Erosion Analysis, Experime	ntal M920F3		15. NUMBER OF PAGES
Kinetic Energy Round	1410.671.57		16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18
298-102

REPORT DO	Form Approved OMB No. 0704-0188					
Public reporting burden for this failection of information is estimated to average. I have per Publicine, including the time for reviewing matrixidian, searching existing data soution, gailbeing and maintaining the data proded and competing and reviewing the collection of information. Sond comments regarding this burden distinct or only other aspect of this collection of information. Circulating suggestions for reasoning two burdens to available to the collection of information. Circulating suggestions for reasoning two burdens to available that advantage and circulating suggestions for reasoning the data of the circulating suggestions for reasoning the data of the circulating suggestion for the circulation of the circulation						
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE March 2000	3. REPORT TYPE AND Final	DATES COVERED			
4. TITLE AND SUBTITLE			5. FUNDING NUMBERS			
DYNAMIC SCALING IN CELLULA SIMULATIONS OF DEPOSITION PI			AMCMS No. 6227.20.9471.2			
5. AUTHOR(S) Mark Johnson		Control of the Contro				
7. PERFORMING ORGANIZATION NAM	ME(S) AND ADDRESS(ES)		B. PERFORMING ORGANIZATION REPORT NUMBER			
U.S. Army ARDEC Benet Laboratories, AMSTA-AR-CCE Watervliet, NY 12189-4050	s-o		ARCCB-TR-00004			
9. SPONSORING/MONITORING AGEN	CY NAME(S) AND ADDRESS(ES		10. SPONSORING/MONITORING AGENCY REPORT NUMBER			
U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000						
10 be presented at the High Performan To be published in proceedings of the		Washington, DC, 16-20 A	pril 2000.			
12a. DISTRIBUTION / AVAILABILITY ST Approved for public release; distribution			12b. DISTRIBUTION CODE			
13. ABSTRACT (Maximum 200 words) Cellular automata simulations can be used to capture many of the essential features of processes that are difficult to model. They are particularly useful in the study of nonlinear dynamical systems that have complex continuous solutions. In this study, cellular automata models have been employed to investigate the nature of the vapor deposition process by exploring the natural evolution of dynamical dissipative systems using self-organized critical system analysis and spatial scaling measures. A new numerical technique is introduced to analyze the intrinsic structure of evolving surface topography in an effort to better understand the dynamics of the growth processes. This technique is being used to validate the integrity of deposition models through a comparative analysis with experimental data and to determine if a correlation exists between intrinsic surface structure and parameters controlling the deposition process.						
14. SUBJECT TERMS Image Processing, Fractals, Cellular A	utomata		15. NUMBER OF PAGES			
mage 110003mg, tradais, Cellulai M	· ·		16. PRICE CODE			
	R. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFI OF ABSTRACT	CATION 20. LIMITATION OF ABSTRACT			
UNCLASSIFIED (INCLASSIFIED	UNCLASSIFIED	UL			
NSN 7540-01-280-5500			Standard Form 298 (Rev. 2-89) Prescribed by ANSI 3td. 239-16 298-102			

REPORT D	OCUMENTATION P	AGE		Form Approved OMB No. 0704-0188		
Public reporting burden for this collection of infigathering and maintaining the data needed, and collection of information, including suggestions Davis highway, Suite 1204, Arlington, VA 22202						
AGENCY USE ONLY (Leave blan		3. REPORT TYPE AN				
4. TITLE AND SUBTITLE	,	1 11111	5. FUND	ING NUMBERS		
ENERGY-DISPERSIVE, X-RAY R MEASUREMENTS OF POROUS S			AM	CMS No. 6111.01.91A1.1		
AUTHOR(S) D. Windover (Benet and RPI, Troy, A. Kumar (SUNY Albany), H. Bakh (Texas Instruments, Dallas, TX), and						
7. PERFORMING ORGANIZATION NA	AME(S) AND ADDRESS(ES)			DRMING ORGANIZATION RT NUMBER		
U.S. Army ARDEC Benet Laboratories, AMSTA-AR-CC Watervliet, NY 12189-4050	CB-O		AF	RCCB-TR-00005		
9. SPONSORING/MONITORING AGE	NCV NAME(S) AND ADDRESS(ES	;}		ISORING/MONITORING NCY REPORT NUMBER		
U.S. Army ARDEC						
Close Combat Armaments Center						
Picatinny Arsenal, NJ 07806-5000						
11. SUPPLEMENTARY NOTES Submitted to Applied Physics Letters						
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.						
13. ABSTRACT (Maximum 200 words) X-ray reflectivity has been used to nondestructively measure the density of thin, porous, SiO ₂ -based xerogels. Critical angle, defined by total external reflection, was measured for multiple x-ray energies to correct for sample misalignment error in the determination of the density for the films. This density was used to extrapolate the percentage of porosity, assuming a bulk SiO ₂ density standard. The results were compared to those obtained by Rutherford backscattering and ellipsometry techniques. 14. SUBJECT TERMS 15. NUMBER OF PAGES						
X-Ray, Reflectivity, Xerogels, Densi	ity			7 16. PRICE CODE		
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NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89) Prescribed by ANSI Std. 239-18 298-102

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6. AUTHOR(5) J.H. Underwood			Morticeresis dynamical aumora s'ale	
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9. SPONSORING/MONITORING AGE	NCY NAME(S) AND ADDRESS	(ES)		ISORING/MONITORING ICY REPORT NUMBER
U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			National reasons and companies represent	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY Approved for public release; distribu			12b. DIS	TRIBUTION CODE
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13. ABSTRACT (Maximum 200 word In June 1999, Dr. Cote supplied a pr Gun Bore Surfaces," and requested the	epublication copy of his and M	r. Rickard's report, "Gray omments are offered here	Layers and the	e Erosion of Chromium Plated
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Form Approved
OM8 No. 0704-0188

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6. AUTHOR(5)			
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7. PERFORMING ORGANIZATION NAM	AE(S) AND ADDRESS(ES)		8. PERFORMING ORGANIZATION REPORT NUMBER
U.S. Army ARDEC			
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9. SPONSORING/MONITORING AGEN	CY NAME(S) AND ADDRESS(E	:5)	10. SPONSORING/MONITORING AGENCY REPORT NUMBER
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Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			
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11. SUPPLEMENTARY NOTES Submitted to <i>Ironmaking and Steelmak</i>	ing (UK)		
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13. ABSTRACT (Maximum 200 words)			<u> </u>
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NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89) Prescribed by ANSI 5id 239-18 298-102

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4. TITLE AND SUBTITLE			5. FUNDING NUMBERS	
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6. AUTHDR(5) Paul J. Cote				
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U.S. Army ARDEC Benet Laboratories, AMSTA-AR-Co Watervliet, NY 12189-4050	СВ-О		ARCCB-TR-00008	
9. SPONSORING / MONITORING AG	ENCY NAME(S) AND ADDRESS(ES)	10. SPONSORING/MONITOR AGENCY REPORT NUMB	
U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000				
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY Approved for public release; distribu			126. DISTRIBUTION CODE	
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A brief review of the controversy r hydrogen cracking beyond the initi cracking model and the general obs hydrogen cracking, despite the plaus	ation stage is also addressed. Coervations of the survey study off	onsideration of some of t	the implications of the proposed	hydrogen-
14. SUBJECT TERMS Gray Layers, Hydrogen Cracking, C Erosion, Damage Initiation	Thromium Spallation,		15. NUMBER OF P 12 16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASS OF ABSTRACT UNCLASSIFIED	SIFICATION 20. LIMITATION OF	
NSN 7540-01-280-5500			Standard Form 298 (1 Prescribed by ANSI Std. 239 298-192	Rev 3-89)

Form Approved OM8 No. 0704-0188

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1. AGENCY USE ONLY (Leave blank)	AGENCY USE ONLY (Leave blank) 2. REPORT DATE 3. REPORT TYPE A June 2000 Final	
4. TITLE AND SUBTITLE SIMULATION OF SHOT IMPACTS FOR THE MIAI TANK GUN		5. FUNDING NUMBERS AMCMS No. 6226.24,H191.1
6. AUTHOR(5) Ronald Gast, Steven Morris, and Mark Costello (Oregon State University, C	Corvallis, OR)	
7. PERFORMING ORGANIZATION NAME	(5) AND ADDRESS(ES)	B. PERFORMING ORGANIZATION REPORT NUMBER
U.S. Army ARDEC Benet Laboratories, AMSTA-AR-CCB-O Watervliet, NY 12189-4050		ARCCB-TR-00009
9. SPONSORING/MONITORING AGENCY	NAME(S) AND ADDRES	(ES) 10. SPONSORING / MONITORING AGENCY REPORT NUMBER
U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000		
11. SUPPLEMENTARY NOTES Presented at the 9 th U.S. Army Gun Dynar Published in proceedings of the symposium		VA, 17-19 November 1998.
12a. DISTRIBUTION/AVAILABILITY STATE	TEMENT	126. DISTRIBUTION CODE
Approved for public release; distribution (inlimited.	
13. ABSTRACT (Maximum 200 words)		

Never has the need for simulation in design of components been more acute. Today's business environment requires innovative thinking in product development, especially for the 'big-ticket' ordnance items such as main battle tanks and armament. The manufacturing costs of these tems and related components prohibit use of the classical method of product development, which includes initial design, prototype manufacture, system testing, and redesign. The answer lies in the use of virtual performance simulation to assess a system's response before any hardware is manufactured. Up-front costs are greatly reduced since the system components reside in virtual space, allowing for rapid electronic design changes and optimization by simulation rather than iterative testing of costly hardware.

One must not be overly enamored by the power and function of the simulation tools. They are just mathematical models written by mere mortals, the execution of which closely mimics nature but does not actually reproduce it. Ultimately, these simulations need to be validated before one becomes comfortable in their use. There are various ways to validate a simulation code. First, one may use dedicated and controlled ests void of extraneous noise to establish relational characteristics among a few test variables. The results may then be directly compared to simulations, with validation achieved when output closely matches the test data. The second method involves comparing simulated results to inherently noisy field-generated test data. The best one may expect to achieve from this type of validation is trends in the responses relative o variations in the system parameters. It is the purpose of this report to validate a coupled simulation package for the accuracy assessment of arge caliber weapons. The simulation packages include SIMBAD, a finite element gun dynamics code, and BOOM, a projectile flight dynamics code. These two models have been coupled so that the output of SIMBAD is the input to BOOM. Simulated results are compared to field-generated accuracy firings for the M1A1 tank, thus method two validation was used to assess the worth of this endeavor.

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NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89) Prescribed by ANSI 5td 239-18 298-102

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NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)

Prescripted by ANSI Std. 239-18 253-102

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4. TITLE AND SUBTITLE	July 2000	Final	5. FUNDING NUMBERS		
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6. AUTHOR(S) S.L. Lee, D. Windover (Benet and RI M. Doxbeck, and TM. Lu (RPI)	PI, Troy, NY),		granament and a second		
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Martensite, Coatings, Thin Films, X-I	Ray Diffraction, X-Ray Reflectivi	ty	16. PRICE CODE		
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Standard Form 298 (Rev. 2-89) Prescribed by ANSI Std 239-18 298-102

NSN 7540-01-280-9500

Form Approved OMB No. 0704-0188

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13. ABSTRACT (Maximum 200 word	\$)		
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14. SUBJECT TERMS Benet Laboratories, Technical Public	ations, Bibliographies, Abstracts, I	Occument Control Data	15. NUMBER OF PAGES 34 16. PRICE CODE
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Standard Form 298 (Rev. 2-89) Prescribed by ANS: 5td. 295-16 295-102

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4. TITLE AND SUBTITLE			5. FUNDING NUMBERS
EFFECT OF SPUTTERING PARAM TANTALUM COATINGS FOR GU			AMCMS No. 6111.02.H671.1
6. AUTHOR(5) Dean W. Matson (Pacific Northwest Edwin D, McClanahan (Pacific North Sabrina L. Lee, and Donald Windove	west), Joseph P. Rice (Pacific Nort		·
7. PERFORMING ORGANIZATION NA	AME(S) AND ADDRESS(ES)		8. PERFORMING ORGANIZATION REPORT NUMBER
U.S. Army ARDEC Benet Laboratories, AMSTA-AR-CC Watervliet, NY 12189-4050	В-О		ARCCB-TR-00014
9. SPONSORING/MONITORING AGE	NCY NAME(S) AND ADDRESS(ES)	10. SPONSORING / MONITORING AGENCY REPORT NUMBER
U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			
11. SUPPLEMENTARY NOTES			
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Approved for public release; distribut	ion unlimited.		
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14. SUBJECT TERMS Sputtering, Tantalum, Triode, Alpha-	Tantalum.		15. NUMBER OF PAGES
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Davis Highway, Suite 1204, Arrington, YA 22202-	302, and to the Ornse or Management and		
1. AGENCY USE ONLY (Leave blank,	2. REPORT DATE October 2000	3. REPORT TYPE AND Final	DATES COVERED
4. TITLE AND SUBTITLE	<u> </u>		5. FUNDING NUMBERS
CANNON COATING EROSION MODEL WITH UPDATED M829E3 EXAMPLE		medicionidata e e e e e e e e e e e e e e e e e e	PRON No. GENERAL DYNAMICS
6. AUTHOR(5) Samuel Sopok			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)			B. PERFORMING ORGANIZATION REPORT NUMBER
U.S. Army ARDEC Benet Laboratories, AMSTA-AR-CCE Watervliet, NY 12189-4050	nago ingerija prija prij	ARCCB-TR-00015	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)			10. SPONSORING/MONITORING AGENCY REPORT NUMBER
U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000			
11. SUPPLEMENTARY NOTES			
Presented at the 36th AIAA Joint Propu Published in proceedings of the conference		, 16-19 July 2000.	
12a. DISTRIBUTION / AVAILABILITY ST	TATEMENT		12b. DISTRIBUTION CODE
Approved for public release; distribution	on unlimited.		
erosion model for cannons with bore coating gun systems with bore coatings. The erosic system firing data and subsequent laborate publish the details of this model. Coared cotypically spall instead of progressively abla firing-induced cannon erosion mechanism. Heat-check cracking of the bore Bore coating shrinkage leading to Combustion gas-induced interface. Abrupt interfacial spalling of the Subsequent substrate metal gas to A very fine bore coating crack provid. In contrast, a progressively widened/extendental substrate producing substantial interfit the resultant cannon coating erosion model	sary to reduce erosion in current and igs. Since that time, our results from no model for cannons with bore coating annon bore erosion does not simply p te. This is the only known erosion in The typical mechanism includes: coating o progressive widening of these crack ee degradation of the exposed substrata bore coating platelets due to linked it wash-to-erosion condemnation ies a narrow combustion gas path to the led bore coating crack due to firing-in caid substrate degradation. The purp show how this very critical coating on prediction for the experimental no as significantly alters the M829E3 erosion.	this model have been published ags is guided and calibrated an confidence in the model has roceed in an outward to inward odel for cannons with bore coa se metal therfacial degradation that form the metal substrate thus produc aduced bore coating shrinkage use of this report is to review ty a model incorporates into our anablative M829E3 kinetic ener	ing limited interfacial substrate degradation. provides a wide combustion gas path to the pical cannon erosion mechanisms, highlight overall cannon erosion code, and provide an gy tank round with and without HEAT-type
OF REPORT	S. SECURITY CLASSIFICATION OF THIS PAGE INCLASSIFIED	19. SECURITY CLASSIFIC OF ABSTRACT UNCLASSIFIED	ATION 20. LIMITATION OF ABSTRACT

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89) Prescribed by ANSI Std. 239-16 298-102

REPORT DOCUMENTATION PAGE			Form Approved OM5 Nc. 0704-0188		
Public reporting Europe for this collection of information is estimated to everage 1 hour per response, including the time for represent instructions, searching existing data existing data existing data existing data existing and committee of any other against at this collection of information, including suppose turns for educing this Europe in Cashington Headquarten Services, Directorate for information, including suppose under colduring this Europe in Cashington Headquarten Services, Directorate for information and Open Grant Services (212 Artists on Davis Highway, Suite 1264, Arthroport, VA 22202-1302, and to the Ortice of Management and Budger Paperwork Reduction Project (0704-0188). Washington, DC 20003.					
1. AGENCY USE ONLY (Leave bla	nk) 2. REPORT DATE November 2000	3. REPORT TYPE AND	DATES COVERED		
4. TITLE AND SUBTITLE	1 1000000		5. FUNDING NUMBERS		
RECOIL CONSIDERATIONS FOR RAILGUNS			AMCMS No. 6226.24.H191.1		
6. AUTHOR(S)		The state of the s			
Eric L. Kathe					
7. PERFORMING ORGANIZATION N	SAME(S) AND ADDRESS(ES)		8. PERFORMING ORGANIZATION REPORT NUMBER		
U.S. Army ARDEC Benet Laboratories, AMSTA-AR-C Watervliet, NY 12189-4050	CCB-O	e construire de la cons	ARCCB-TR-00016		
S. SPONSORING/MONITORING AG	ENCY NAME(S) AND ADDRESS(ES)		10. SPONSORING / MONITORING AGENCY REPORT NUMBER		
U.S. Army ARDEC Close Combat Armaments Center Picatinny Arsenal, NJ 07806-5000					
	ic Launcher Symposium, San Francis				
•	•				
12a. DISTRIBUTION / AVAILABILITY			12b. DISTRIBUTION CODE		
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13. ABSTRACT (Maximum 200 wor	ds)				
The objectives of the future combat nominally twenty tons. Prior exper concern that firing large caliber an	t system program call for similar leth ience with the M551 Sheridan, a ligh	ality to a current heavy tan at tank first put into produce talt in unacceptable crew of	ner, and ultimately the weapon platform. It on an extremely lightweight vehicle of extion by the United States in 1966, raises liscomfort and vehicular reaction during ecoil.		
			100000000000000000000000000000000000000		
14. SUBJECT TERMS Railgun Recoil, Mechanical Shock Isolation,			15. NUMBER OF PAGES		
Weapon System Integration, Recoil			16. PRICE CODE		
17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFIED OF ABSTRACT	CATION 20. LIMITATION OF ABSTRACT		
UNCLASSIFIED NSN 7540-01-280-5500	UNCLASSIFIED	UNCLASSIFIED	Standard Form 298 (Rev. 2-89)		
The state of the s			Prescribed by ANSI 518, 239-18 298-102		

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